NOTES ON THE OCCURRENCE OF ALPINE TYPES IN THE VEGETATION OF THE HIGHER PEAKS OF THE SOUTH-WESTERN REGION OF THE CAPE.

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(Plates XXII., XXIII., XXIV.)

In ascending the higher mountains of a country one notices a more or less gradual change in the vegetation, according to the different altitudes. Although the mountaineer may have no knowledge of botany, he recognises the great difference in the general habit of growth of the plants of the higher and lower regions.

Long-continued observation and cultivation of plants on high mountains and in the plains have shown that the characteristics of Alpine vegetation are principally due to the Alpine climate, and not to the peculiarities of the soil. As far as the climate is concerned, it is often thought that the principal factor in shaping the plants is the cold and frost, owing to which the plants are not able to reach greater dimensions. It is thought that the vegetation of high mountains, particularly of those above the snow line, is subject to similar conditions as that of the Arctic regions, and that consequently these two vegetations should be more or less identical.

But that is not so, and although in some respects such similarity exists, we find a great difference in others. Common to both climates are the low temperature and the excess of light, but in both respects there is a great difference of actual conditions. While the Arctic plants, even in summer, are exposed to an only moderate heat, those of the Alpine regions have to resist extreme heat and cold in rapid succession, owing to the powerful insolation and radiation in the rarefied air of the higher elevations.

More pronounced even is the difference in the amount of illumination which they receive, for while in the former case the light is weak but continuous, it acts only periodically but with great intensity in the latter, and while the risk due to the want of water is caused in the Alpine regions by the occasional extreme dryness of the air, this

occurs in the Arctic zone through the coldness and the freezing of the soil.* It is consequently not surprising that comparatively few species only are common to the Arctic and Alpine regions, and that there is a great difference in the vegetation of both, not only as far as the species of plants are concerned, but specially also with regard to their general habit of growth and their external as well as internal structure.

If we examine the vegetation of Alpine regions we find that it is characterised by the absence of trees, tall shrubs, and high herbaceous plants. On the other hand, new forms and modes of growth appear or become more numerous. Many plants produce no central stem but a large number of very short stems, packed so closely together that they form an almost solid cushion—a mode of growth well known among mosses—while others develop only a rosette of leaves close to the ground; almost all possessing a very large system of roots. There are other special features in their appearance. Their leaves are mostly hairy or leathery, which peculiarities are not protections against the cold but against the heat; that is to say, they protect the plants against the loss of too much water during the hours or days when the surrounding air is hot and dry.

We here at the Cape are, of course, familiar with many plants which secure their existence during the dry and almost rainless summer in a similar way; the silver-tree, the everlastings, and many other plants being protected by a coat of fur, while the Proteas illustrate the leathery foliage. These and many other peculiarities of structure in our vegetation are principally due to the necessity of regulating the transpiration of the leaves; they are characteristic of xerophilous plants. Consequently, while in Northern and Central Europe the xerophilous characters form the principal distinction between the vegetation of the lower and higher regions, we cannot expect this to be the case here, for protection against excessive transpiration is wanted in the valleys as well as on the mountain-tops. In fact, the climate of the higher mountains is moister than that of the plains. This is due partly to the snow which remains on some of the higher peaks for months, and appears on the Hex River range even as late as Christmas. Much more important in this respect are, however, the clouds which cover the mountains during the south-east winds, for then considerable quantities of moisture are deposited, which gradually soaks into the ground and the fissures of the rocks, thus often feeding springs quite close to the top of a mountain.

This greater amount of moisture causes the existence of a much

* *Schimper*, Pflanzen-Geographie auf Physiologischer Grundlage, Jena, 1898.

more considerable vegetation. Every ledge, every corner, every crack is filled with it, and often one finds on the very top of the mountains thickets of shrublets covered with flowers, wherever there is a place sheltered by the boulders against the wind. Yet every one of the plants, with the exception of those which grow under rocks or in caves or in other sheltered places, shows unmistakably its xerophilous nature. Leathery leaves and coatings of felt and hairs are as numerous here as in the valley, for the insolation of the sun is intense and the rarefied air favours evaporation. [See Plate XXII.]

If one ascends one of the higher mountains, *e.g.*, the Great Winterhoek near Tulbagh, one passes the last arborescent shrubs at an elevation of about 4,000 feet, where in ravines and sheltered corners *Cunonia capensis*, *Olea verrucosa*, *Mimetes cucullata*, and a few others manage to find sufficient moisture even in summer. Higher up only low shrubs of heath, composites, Bruniaceæ, Rutaceæ, Thymelæaceæ, &c., cover the slopes, becoming smaller and more compact the further one ascends. [See Plate XXII.] There is, however, no perceptible change in the general appearance of the vegetation until one reaches an altitude of about 6,000 feet. Then only forms appear which remind one of the peculiarities of Alpine vegetation, and the higher one rises the more numerous become these types.

There are not many mountains in the South-Western part of the Colony which exceed that height, and about some of them, *e.g.*, the summits of the Zwartebergen range, nothing is known botanically. The Hex River range, which culminates in the Matroosberg, 7,430 feet, possesses several peaks which are between 6,000 and 7,000 feet above sea-level, but, with the exception of the Matroosberg itself, they have not as yet been explored. Besides these, there are only the Mostert's Hoek, 6,670 feet; the Du Toit's Peak, 6,580 feet; and the Great and Little Winterhoeks, near Tulbagh, 6, 840 and 6,400 feet respectively, which exceed a height of 6,000 feet.

It was on these five mountains that I gathered, above that level, the 72 plants mentioned in the following list. They do not, however, represent the whole flora, for I have visited some of these mountains only once, and others, *e.g.*, the Great Winterhoek, always at the same season, viz., in midsummer.

Anemone capensis L. var.
Heliophila nubigena Schlechter. Leaves hairy.
Drosera pauciflora Banks, var. *acaulis*. A very dwarf form, but the flower as large as a leaf.
Cerastium capense Sond.

Oscalis spec.? Leathery leaves.

Pelargonium spec. non-descr. In fissures of rock with a thick woody root and small entire leaves, close together and tightly pressed against the rock.

Diosma teretifolia Link. The branches of this shrublet are spread out over rocks.

Barosma latifolia R. and I.

B. Marlothii Schlechter. Both species form small shrubs with a mass of upright branchlets. Between small boulders of stony slopes.

Agathosma alpina Schlechter. Similar in habit to the preceding species, but smaller.

Phylica chionophila Schlechter. Small compact shrub.

Aspalathus nivalis Schlechter. A miniature shrub with thick branches lying flat on the ground, somewhat like *Salix herbacea*. Plate XXIV., fig. 2.

Aspalathus ? spec.?

Cyclopia Bowieana Harv. Leathery leaves.

Cœlidium humile Schlechter. Leaves very small, silvery white. Plate XXIV., fig. 1.

Amphithalea spec.?

Cliffortia Dregeana Presl. Very hairy.

,, *juniperina* L. Hairy.

,, *pungens* Presl. Very hairy.

,, spec.?

Crassula papillosa Schönland. Under rocks.

Crassula spec.?

Tittmannia laxa Sond. Tiny shrublets.

Berardia velutina Schlechter. Velvety.

Mesembryanthemum spec.?

Psammatropha quadrangularis Fenzl. Forms cushions up to six inches in diameter. Plate XXIV., fig. 3.

P. frigida Schlechter. Plate XXIII., fig. 2.

Hydrocotyle Centella Ch. & Schl. var. *coriacea* Harv. Similar to normal form but smaller.

Sarcocephalus ciliatus Schlechter.

Bryomorphe Zeyheri Harv. Leaves hairy, white.

Cineraria tomentosa Less. Leaves hairy, white.

Cenia spec.? Hairy.

Felicia bellidioides Schlechter. Leaves villous. Plate XXIII., fig. 1

Gazania pinnata L. var. Very hairy.

Helipterum canescens DC. Covered with white felt.

Helichrysum spec. duæ. White felt.

Leontonyx spathulata L. var. White felt.
Relhania spec.? Hairy.
Senecio Marlothii Schlechter. White felt.
Stoebe spec.? White felt.
Ursinia macropoda N. E. Br. Hairy.
Prismatocarpus subulatus DC. var. *alpina.* Branchlets numerous, closely matted into each other.
Roella spec.?
Erica cristæflora Salisb.
,, *Junonia* Bolus.
,, *lutea* var. *rosea.*
,, *nubigena* Bolus.
,, *oresigena* Bolus. Leaves whitish.
,, *Sebana.* Short compact shrublets.
,, *tumida.* Straggling over stones and boulders.
,, species duæ ignotæ.
Nyctaginia ovata. In the shelter of rocks.
Zalusianskia dentata Bth. var. Similar spots.
Phyllopodium glutinosum Schlechter.
Selago spuria L.
Lachnæa buxifolia Lam.
,, *diosmoides* Meissn.
,, *eriocephala* L. var. *purpurea.*
,, *Marlothii* Schlechter.
Protea saxicola R. Br. A dwarf decumbent shrub, its branches spreading over stones or pressed against rocks.
P. scolopendrium R. Br. var. No stems, but many very short branches, the large flower-head almost flush with the ground.
Thesium microcephalum Schlechter. Depressed shrublet.
Nanolirion capense Hook. On the Little Winterhoek, Great Winterhoek, and Matroosberg. The specimens from the latter locality are much larger than those from the Little Winterhoek, upon which the genus was established.
Dipidax ciliata Bkr.
Gladiolus oreocharis Schlechter.
Romulea rosea Ecklon, var.
Ixia flexuosa L. var.
Aristea capitata Ker.
Restiaceæ form the bulk of the vegetation, growing socially in tufts or large patches. [See Plate XXII.]
Several Graminaceæ and Cyperaceæ.

These plants represent the following orders and genera

Ranunculaceæ 1; *Cruciferæ* 1; *Drosera* 1; *Caryophyllaceæ* 1; *Oxalis* 1; *Pelargonium* 1; *Rutaceæ* 4; *Phylica* 1; *Papilionaceæ* 6; *Cliffortia* 4; *Crassula* 2; *Bruniaceæ* 2; *Ficoideæ* 3; *Umbelliferæ* 1; *Rubiaceæ* 1; *Compositæ* 13; *Campanulaceæ* 2; *Erica* 9; *Scrofulariaceæ* 3; *Selago* 1; *Thymelæaceæ* 4; *Protea* 2; *Thesium* 1; *Liliaceæ* 2; *Iridaceæ* 4; *Restiaceæ* ?; *Graminaceæ* ?; *Cyperaceæ* ?.

From this list, although necessarily very incomplete as yet, it is evident that the general systematic composition of the flora is practically the same as that of the lower slopes and valleys. It includes a few species known from the plains below, a number of others known from the foot of the mountains, and some, *e.g.*, *Erica Sebana*, *Bryomorphe Zeyheri*, and *Anemone capensis*, which are also met with at or below the altitude of Table Mountain, 3,549 feet.

On the other hand, I must point out that in several cases the specimens from the high regions represent a distinct variety, which some botanists would probably distinguish as new species. A striking example of this kind is *Anemone capensis*. While in the ravines and on the slopes of the eastern side of Table Mountain this plant possesses mostly solitary stems one or two feet high, the variety on the Matroosberg * produces a large number of stemless shoots, growing in such close proximity to each other that the finely divided leaves form a flat cushion, a foot or more in diameter. From this compact mass of leaves rise the numerous peduncles 6 to 8 inches high, bearing flowers as large as those of the tall plants of Table Mountain, but much more hairy and more intensely coloured than those, being bright rose inside as well as outside. This Alpine form is a beautiful example of the influence of the intense light, of the furious winds, the occasional extreme dryness of the atmosphere, and, I think, of the merely mechanical pressure of the snow which falls at these altitudes sometimes as late as December. It was a most interesting sight to find one day in October hundreds of anemones projecting through a firm layer of freshly fallen snow on a slope ot the Sneeuwkop, just as one can see the tiny *Soldanella* fringe the snowfields of the Alps.

Other plants of typical cushion-like growth are *Psammatropha quadrangularis* [Plate XXIV., fig. 3], which resembles in its growth a fair-sized patch of *Polytrichum commune* and *Bryomorphe Zeyheri*, of which the name indicates this habit, but which plant is also found at somewhat lower levels. *Prismatocarpus subulatus*, *Crassula papil-*

* This is not merely the form mentioned in the "Flora Capensis," vol. i., p. 3, as var. *tenuifolia*, for it differs from the type not only in its leaves but also in the flowers.

losa, and *Leontonyx spathulata* form similar pads, and *Pelargonium* [spec. non-descr.] bears shortly petiolate leaves of the size of a sixpence, on a woody root of the thickness of a finger hidden in the cracks of the rock, against whose surface the leaves are closely pressed, while *Psammatropha frigida* is just like some Alpine species of *Saxifraga* or *Androsace*, *e.g.*, *S. bryoides*. [Plate XXIII., fig. 2.]

The stunted but extremely social growth of Rhododendron in its smallest forms is well represented by *Cœlidium humile*, and two species of *Barosma*, and the thick, woody rooted, but stemless habit, by *Protea Scolopendrium*, while the decumbent shrublets, *Protea saxicola*, *Erica tumida*, and *Diosma teretifolia*, spread over rocks and boulders somewhat after the style of *Juniperus nana*. Even the typical form of growth of *Salix herbacea* is not wanting, for *Aspalathus nivalis* possesses horizontal stems a quarter of an inch in diameter, lying flat on the ground, while its numerous erect branchlets with leaves and flowers are hardly an eighth of an inch high. [Plate XXIV., fig. 2.] Plants with rosettes of leaves abound also at lower levels, but *Senecio Marlothii* and *Felicia bellidioides* exhibit this peculiarity in a most marked degree. [Plate XXIII., fig. 1.]

One general feature, however, is specially noteworthy, viz., that all the plants with permanent foliage are thickly coated with hairs, or are provided with leathery leaves and a thick epidermis. All the composites (14) are not only hairy, but more or less covered with white felt, showing that the plants of these altitudes are even more xerophilous than their nearest allies of the lower regions.

On the other hand, as the vegetation of these lower regions is also typically xerophilous, and as a few summits only of our mountains reach the altitude of permanent winter snow, it is evident that the conditions for an entirely Alpine flora, well distinguished from that of the valleys, are not present.

One point, however, must be borne in mind, and that is the incompleteness of the knowledge of this flora at our disposal. This is well illustrated by the fact that among the 72 species enumerated above there are 16 species described only recently, 14 of which were gathered by me in a single day. There is no doubt that a good many more species are awaiting discovery, and that a number of truly Alpine forms will be found among them.

PLATES XXII.–XXIV.

Plate XXII.

Part of the Hex River range, the photograph being taken in May, 1899, at an altitude of 4,500 ft. The vegetation consists of Restiaceæ, with shrublets of *Protea* and *Leucadendron*. The rock is Table Mountain sandstone.

Plate XXIII.

Fig. 1.—*Felicia bellidioides*, Schlechter.

The leaves are covered with white felt. This species occurs from 6,000 ft. upwards. The specimen figured was gathered near the summit.

Fig. 2.—*Psammatropha frigida*, Schlechter.

A very small plant, the specimen represented being the largest one found.

Plate XXIV.

Fig. 1.—*Cœlidium humile*, Schlechter.

The shrublet of which the figure represents about one-tenth was only six inches high.

Fig. 2.—*Aspalathus nivalis*, Schlechter.

This shrublet spreads on the surface of the ground. When not in flower it would look somewhat like a cushion of moss.

Fig. 3.—*Psammatropha quadrangularis*, Fenzl.

This plant forms thick cushions similar in structure to those of *Polytrichum commune*. The figure represents about a twentieth part of such a cushion.